

## 1 **OBSTRUCTIVE PULMONARY CONDITIONS & ITS OCULAR IMPLICATIONS**

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### 2 **Course Description**

- This course focuses on giving an introduction and review of common obstructive pulmonary diseases and conditions
- This course will also highlight some ocular consequences of these pulmonary diseases and conditions
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### 3 **Course Objective**

- Briefly introduce and define obstructive pulmonary disease
- To review types of obstructive pulmonary diseases in detail: asthma, COPD, cystic fibrosis and obstructive sleep apnea
- To highlight how these pulmonary conditions relates to optometry and what ocular manifestations can result from these conditions

### 4 **Outline**

- Introduction
- Introduction of obstructive pulmonary disease
- Types of obstructive pulmonary disease:
  - 1. Chronic lower respiratory disease:
    - Asthma
    - COPD
      - *Emphysema*
      - *Chronic bronchitis*
    - Cystic fibrosis
  - 2. Upper respiratory tract:
    - Sleep Apnea

### 5 **Optometric considerations**

- Pulmonary disease can increase the risk of ocular disease
  - Dry Eye
  - Glaucoma
  - ARMD
  - Retinal vascular changes
  - Optic nerve head changes
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- Pulmonary disease can contraindicate ocular medications

### 6 **Optometric considerations**

- Medications taken for pulmonary disease can cause ocular problems
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- Medications taken for pulmonary disease can cause ocular problems
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- Optic atrophy
- Glaucoma
- Cataract
- Blurred vision
- Tear effects
- Conjunctivitis

7  **Lung disease**

- Top 4 causes of death in adults
- Every year, > 200,000 Americans die of lung disease in US

8  **Lung disease is common**

- Lung disease is not only a killer, most lung disease is chronic
- > 35 million Americans are living with chronic lung disease
- Smoking is directly responsible for 90% of lung cancer and causes most cases of emphysema and chronic bronchitis

9  **Symptoms of Lung Disease**

TWO common symptoms of lung disease

1. Dyspnea
  - Shortness of breath (SOB)
  - Can be caused by lung or heart disease
2. Chronic cough
  - Production of phlegm
  - Hemoptysis: *heme* (blood); *ptysis* (to spit) – coughing blood

10  **Atypical symptom of Lung Disease**

Chest pain is not a common symptom

- Lung tissue has no pain receptors
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- Pain is possible with:
- Pleural disease
- Pulmonary vascular disease
- Musculoskeletal pain

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- Emphysema*
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## 12 Introduction to Obstructive pulmonary disease

- Definition: Limitation of airflow *especially* on exhalation (*passive process*)
- Makes breathing harder
- Can be caused by:
  - 1. Change in lumen size
    - Altered secretions in asthma or cystic fibrosis
  - 2. Thickening of airway wall
    - Inflammation in bronchitis and remodeling in asthma
  - 3. Changes in supporting structure surrounding the airway
    - Emphysema

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## 14 Asthma

- Common syndrome found in 1 in 12
- Genetic predisposition to type I hypersensitivity
- There are different asthma phenotypes
  - Some have ↑ IgE, some ↓ IgE
  - Treatment is all the same currently
  -
- More likely to have asthma:
  - Children: can grow out of it
  - Females: smaller pipes
  - African American: genetically more susceptible

## 15 Asthma

- Characterized by exacerbations and remissions
- Initiating factors include:
  - Allergens, heat, stress, cold, dust, smoke, dander, pollen, fragrance, menstrual cycle,

15 

- Initiating factors include:
  - Allergens, heat, stress, cold, dust, smoke, dander, pollen, fragrance, menstrual cycle, obesity, lack of sleep, alcohol, (exercise)

Poor Control:

- 93% of patients with inhalers missed at least one important step for correct use
  - For example: exhaling fully or shaking inhaler before use
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- 1 in 5 children with asthma go to ER for asthma each year

16  **Signs and symptoms**

- Intermittent (patients appear normal between attacks)
- Vary due to range in severity
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Signs/Symptoms include:

- Chronic cough
- Wheezing (if severe, wheezing may not be present)
- Chronic episodic dyspnea (SOB)
- Sympathetic discharge (perspiration/flushing of skin)
- Tightness in chest
- Tachypnea
- Severe cases can have cyanosis of nail beds, confusion, agitation, nasal flaring, difficulty talking, no breath sounds
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17  **Asthma Therapy**Goals:

- Relieve symptoms
- Prevent recurrences of attacks

Therapies:

- Control triggers including smoking cessation
- Exercise and breathing exercises
- Bronchodilators: Adrenergic and Anticholinergics
- Anti-inflammatories
  - Steroid anti-inflammatories
  - Leukotriene inhibitors
  - Mast cell stabilizers
  - Monoclonal antibodies against IgE
  - Vitamin D?
- Thermoplasty – using radiowaves to change shape of airways

18  **Glucocorticoids****1** Most common adverse effects:

- Osteoporosis
- Impaired wound healing
- Increased risk of infection
- Hypertension
- Decreased growth in children (oral >> than inhaled)

**2**

- Hypertension
- Decreased growth in children (oral >> than inhaled)

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- Edema
  - Ulcers
  - Psychoses
  - Cushing-like syndrome
  - Oral candidiasis (Thrush) – use spacer to ↓ risk
  - Glaucoma
  - Cataracts
  - ↑ risk of DM

19  **FDA guidelines:**

Use inhaled glucocorticoids with caution in patients with:

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- Parasitic infection (ex: histoplasmosis)
- Active or inactive TB
- Ocular herpes simplex
- Increased IOP
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\*\*use caution, but not absolute contraindication!

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21  **Chronic Obstructive Pulmonary Disease (COPD)**

Includes two common diseases:

- Emphysema
- Chronic bronchitis
- Slowly, progressive airway obstruction
  - Disease does NOT go away!
- Takes years to become clinically apparent
  - 1<sup>st</sup> symptom: SOB on exertion
  - People tend to subconsciously avoid exertion tasks to mask symptoms
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- 22  **COPD**
- About 15 million US adults have COPD diagnosis
    - Probably more, just undiagnosed
    - Smoking is the #1 cause
      - 6 – 10% of adult pop but up to 50% of smokers
    - Lifetime risk is now estimated at  $\frac{1}{4}$
    - COPD kills more than 120,000 Americans each year
      - 1 death every 4 minutes
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- 24  **Emphysema**
- $\approx$  4 million diagnosed patients in the U.S.
  - Abnormal enlargement of the air spaces due to destruction of alveolar wall
  - Repeated and prolonged inflammation causes release of proteolytic enzymes that digests alveolar septal walls
  - Most common cause: cigarette smoking
    - Tobacco allows destructive enzymes to work over time and destroy alveoli walls
- 25  **Typical emphysema patient**
- "Pink puffer"
- Thin (working to breath all the time)
    - Average person: 4-5% calories breathing
    - Pink puffer:  $\sim$ 30% calories breathing
  - Pursed lips respiration
  - Tripoding
  - SOB and tachypnea (breath quickly)
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### 27 **Chronic bronchitis**

- ≈ 10 million diagnosed patients in the U.S.
- Chronic bronchitis is more common than emphysema: ~3/4 of patients with COPD
- Leading cause is cigarette smoking, also air pollution and infections
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- Definition: Persistent, productive cough on most days for at least 3 consecutive months in 2 consecutive years
  - This defines CHRONIC
  - Anyone with a cold has had bronchitis – but those are acute symptoms
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### 28 **Chronic bronchitis (Smoker's cough)**

- Inflammation of the airways\* with hypertrophy of large airway mucous glands and hypersecretion of mucus\*
- Airway size is compromised and obstructed

#### Clinical manifestations:

- Wheezing - Tremendous mucus production blocking airways
- Crackles - Caused by edema
- Tachycardia is common but not universal
  - Periphery not getting enough O<sub>2</sub> → lungs will breathe faster and heart will pump faster to get blood out
- Polycythemia - ↑ RBC to carry O<sub>2</sub> → ↑ risk of clotting

### 29 **Typical chronic bronchitis patient**

#### "Blue bloaters"

- Stereotypical chronic bronchitis patient
- Chronic cough and expectoration
- Obese, edematous due to right sided heart failure
  - Heart has to push against closed capillaries when there is poor oxygenation of the lungs
- Increased anteroposterior chest diameter – using accessory muscles
- Cyanotic
- CO<sub>2</sub> narcosis can cause decreased memory and info processing ability

### 30 **Chronic bronchitis**

Lack of O<sub>2</sub> causes a lot of ocular problems!

#### Associated with:

- Decreased VA especially at night

Associated with:

- Decreased VA especially at night
- Decreased color vision
- Transient visual obscurations (different from TIA)
- 7% had swollen optic nerve heads
- 82% had decreased retinal function as determined by abnormal VEP
- Increased risk with increased PCO<sub>2</sub> and decreased pH in blood

### 31 **Treatment for chronic bronchitis and emphysema**

No curative therapies but treatment may slow progression

- Goal: control of symptoms and avoiding harmful environments
  - Smoking cessation including vaping
  - Many still smoke with diagnosis
- Pharmaceutical treatment very similar to treatment for asthma

### 32 **Pharmaceutical Tx for chronic bronchitis and emphysema**

Bronchodilators

- Short acting or long acting Beta-2 agonists
- Anticholinergics

Anti-inflammatory drugs

- Glucocorticoids
  - Most useful during exacerbations
  - May decrease number of exacerbations

Combination medications

- Steroid & long acting beta agonists
- Long acting beta agonist/long acting muscarinic antagonist

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### 34 **Cystic fibrosis (CF)**

- Most common lethal genetic disease that affects Caucasians
  - 1 in 3700 live births in North America
  - Autosomal recessive trait:
    - ≈1 in 30 Caucasians are carriers
- Multi-system disease associated with abnormal chloride transport of epithelial cells
  - Either protein is in wrong place or it doesn't function well

- Multi-system disease associated with abnormal chloride transport of epithelial cells
- Either protein is in wrong place or it doesn't function well
- Increases chloride and sodium content in sweat
- "Sweat test": mother's kissing salty child

### 35 **Cystic fibrosis**

#### Pulmonary involvement:

- Infection with normal flora bacteria
- Followed by infection with other bacteria
  - Cilia not working well, can't cough it out!
- Persistent infection and inflammation cause damage to airway walls and obliteration of small airways\*
- Most patients die of pulmonary failure secondary to infection
- Two CF patients cannot be in the same room!

### 36 **Many other organ systems are involved in CF**

#### Any organ system with a duct will likely be affected!

- ↑ thickness of secretions causes blockage
- Poor digestion of fats
- Malabsorption of proteins and carbohydrates
- Infertility (fertility ducts blocked)
- Cirrhosis of liver (liver ducts blocked)
- Increased incidence of sleep apnea (sinuses blocked)

### 37 **Ocular involvement in CF**

#### Abnormal chloride transfer in the eye

- Aqueous deficient dry eye with epithelial staining
- Reduced endothelial cell density
- Increased corneal thickness (edema)
- Posterior sub capsular cataract
- Reduced contrast sensitivity (CI problems in retina)
- Diabetic retinopathy (diabetes more common → pancreas issue)
- Nutritional effects: decreased macular pigmentation; Xerophthalmia

### 38 **Tx of cystic fibrosis**

No cure, try to improve length and quality of life!

#### Airway clearance techniques

- Goal: remove mucus build up to prevent infection
- Medicinal method:
  - Can use dornase alpha (Pulmozyme)
    - Makes sputum less viscous and easier to clear
  - Can cause condition similar to bacterial conjunctivitis

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40  **Sleep apnea**

- Apnea: complete cessation of respiration 10 seconds
- 2 forms of sleep apnea
  - 1. Central:
    - *Not* an obstructive disease
    - *Cheyne-Stokes* respiration: dysfunction in brain respiratory control centers
      - Poor feedback loop: low O<sub>2</sub> gets to brain → breathe MORE → high O<sub>2</sub> → breathe less(stops breathing) → low O<sub>2</sub>.....
    - Often due to heart failure (slow response due to poor blood flow)
  - 2. Obstructive: mechanical (MOST common)

41  **Obstructive Sleep Apnea (OSA)**

- Most common sleep disorder
- Prevalence depends on how defined
- Most agree that 3-7% of adults have mod to severe sleep apnea
- Found in up to 1/4 of males over 20 years of age if include mild forms
- Women less commonly affected (tend to be post menopausal)
- Often undiagnosed (80%)
- Can also occur in children (ex: CF or down syndrome)

42  **Obstructive Sleep Apnea (OSA)**Symptoms

- Loud snoring (patient unaware)
- Chronically disturbed sleep (patient unaware)
- Excessive daytime sleepiness
- Irritability, depression, and personality changes
- Morning headaches
- Tired upon awakening
- Cognitive impairment (MRI scans on mammillary bodies)

43  **OSA pathophysiology**

- OSA is due to complete collapse of upper airway\* in sleep
  - Upper airway: soft palate, uvula, the jaw
  - As patient enters deep sleep, upper airway closes
  - Thrashes, snorts, partially awakens and reopens airway with a gasp
  - Can occur hundreds of time per hour

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#### 44 **OSA contributing factors**

These factors ONLY ↑ risk of having OSA:

- Most patients are obese and have "thick" necks
  - Fat around neck helps occlude airways
- May have small or receding jaw
- May have increased size of soft palate and tongue
- Often a history of heavy drinking
  - Alcohol relaxes muscles and less likely to wake from sleep
- History of asthma

#### 45 **Medical conditions associated with OSA**

- HTN in 30 to 50% with OSA; often difficult to control
  - Treating HTN drops BP by 3-5mmHg ( = to a med)
- Obesity
- Multiple sclerosis (loss of muscle tone)
- Diabetes (3X) (1.7X even if control for obesity)
  - Increased risk of retinopathy, especially macular edema (lack of O<sub>2</sub>)
- Cardiovascular disease (lack of O<sub>2</sub>)
  - Ischemic heart disease, MI and angina (4-7X)
  - Nocturnal cardiac arrhythmias (2- 4X)
  - Stroke (3-8X)
  - Heart failure

#### 46 **Obstructive sleep apnea increases the incidence of some conditions**

\*\*Likely due to decrease in O<sub>2</sub> supply!

- Alzheimer disease/ Brain atrophy/ Cognitive decline
- Emotional problems
- Impotence
- Osteoporosis (2X)
- Glaucoma (7-8% vs 2%) especially normal tension glc
- Anterior ischemic optic neuropathy
- Motor vehicle accidents (MVA) (2 – 7X): falling asleep while driving
- With CPAP use: Corneal dryness, Corneal ulcers, Bacterial ocular infections

#### 47 **THANK YOU**

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